Plant Operations Notebook, N-93-01-10

This notebook covers the period January-February 1893. It was used by Charles Batchelor and Edison primarily for notes, drawings, and calculations from 63 numbered experiments on the magnetic separation process. Notes on experiment 62 are by Walter S. Mallory. The series is followed by drawings, notes, and measurements from a "Duster experiment" and an unnumbered "Concentrate Seperator Experiment." An unidentified graph is inserted near the end of the book. The pages are unnumbered, and the book has been used in both directions. Approximately 140 pages have been used.

Original 57.92

15 coarse + fine 61.54

15 coarse (larger sample) 62.61

15 fine 69.50

After separation by hand magnet

Mesh	50 mesh concentrates	14 mesh crude	Size of mesh in thousands
100.	15.17%	15.69%	6 1/4
90.	4.50.	7.38.	6 4/10
80.	3.70"	1.95.	6 1/3
70.	12.72"	7.13"	11
60.	5.28"	1.78.	8 3/4
50.	15.13"	5.03"	12
40.	20.04"	11.90"	16 1/2
30.	20.54"	10.40"	22 1/2
20.	2.71"	23.46"	38
14.		12.49"	45
Larger 14.		6.63"	
10.	18		
Larger 10.			

65
31
65
195
80

2240
2013
227

545
227
318

6

124
80
2240) 9920 (4.4
8960
960

621
80
49600

2240) 49600 (22.1
4480
12800
11200
1600
1344
256

96.1
124

800
147
653

80
22
58

653
4.4
69.9

45
80
2240) 3288 (14.7
2240
1048
896
152

63
31
63
189
1953

45
31
45
135
139.5

2240
1395
845 — tons
287
558

59
31
59
177
1829

2240
1829
411

2240 45 80 tons 1st mag
1953 59 65.3 tons 2nd mag
287 63 60.9 tons 3rd mag
65 58 — Tons —

40

775 | 40.00 | 0.052
3875
1250
5 3/4

0.52
350
775
1750
1550
2000

2.4
29
216
48
69.6

775 | 69.60 | 0.09
6975
0.50
40,50

8.5 | 690 | 7
690

746 | 21210 | 28.4
1492
5970
5970
5320
5320
9.6
4
38.4
96

775 | 21210 | 27.35
1550
5710
5425
1550
2825
425

134 × 4 × 1 150
12 404 38
402 1728

38.4
66
7280

2.73
3.9
10.7
4.6
6.67

1728 | 15000 | 0.0868
13824
11760 160
10368 1920
13920

21½
8 | 2564
318

66.7
3.16
5.56
6.67
200.1
21210

66.7
3.80
6.64
13.00
1.4
1.0868
746 | 1.44
746
3448
2984
464

| 21.45

1 Cub. inch = 0.0868 lbs

Jan 10 1893

8½ lee 2 rev. 14 per min
2½ amp 28 Volts 1

Magnet separator test
Roller feed cylinder diam 3"
Slot opening ¼ × 6½"

1st Exp.
12 Rev. per min
29 Volts ~~amps~~ amps 2.3
length of magnet 8"

What HP for ~~40~~ 160 feet of this magnet?

66.7 Va. × 240 ÷ 746 =

~~28.4 HP~~

21.45 HP

Tailings in ¼ 1.44 —

60 / 1.25
60
1.25 / 60.00 = 48
500
1100
1100

14 : 1 : 48
14 / 48 = 3.43
56
43

113.50
60
6810
135
18160
4540

2nd Exp

1 turn in 1¼ sec. = 48 turns per min

1 ton a ~~hour~~ on 14 hrs. Hour must is ~~ton~~ 48

3.43 ton per hour

Iron 56.11 in tailings taken

Dimensions of magnet

Iron 8" long 8½ X 2 thick

copper on it 7.25 X 8".25 X 6.25 X 2

= 80.75 cubic inches X 9 =

756.2 copper wire space

X .5 = 378.1 X .30 =

113.43 net copper = copper on magnet 6 feet wide

3rd Exp. #1 position

12 Revs. per min ✓

Tail 1.81

Iron 61.54

4th Exp. Jan 10 1893

1 turn in 11 sec 5.45 revolution per min

Lail. 2.53

Lum 62.35

This was at #2 position & it shows that with a thinner stem as against a thicker one the position of the parting board would have to be more towards the tailings ⅛" to get the tailings back to 1.81 as in former exp.

5th Exp. #3 position parting board ⅛" ~~40 revolutions~~ sieves iron side

3 rev. in 7 sec 26 revolutions

28 Volts. 2.3 amps

Lail 7.24

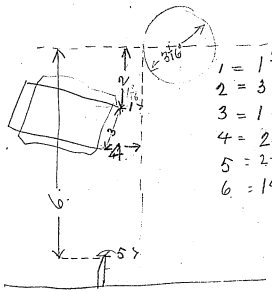
The best test in these exp. is parting board at #2 position & 12 Revolutions

✓

11 60 6.13

60 1:3 60

All succeeding exp. were made with the position of magnet



1 = $1\frac{9}{16}$"
2 = $3\frac{25}{32}$"
3 = $1\frac{29}{32}$"
4 = $2\frac{7}{8}$"
5 = $2\frac{7}{16}$"
6 = $14\frac{5}{16}$"

60 | 5.5 | 600 | 11
5.5
5.5
5.0

3.5 | 600 #7.1
35
25.0
24.5
5.0

9.6
17.2
6.16
12 | 7.3.2
3.6

.25
6.5
1.2.0
1.6.2.5
9.6
9.6.5.0
10.6.2.5
15.6.0.0.0

.0868
15.6
5.2.0.8
3.4.6
8.6.2
1.3.5.4.0.8

1.3.5.4
6.0.2.1
2.0

2.4.0
3.4.0
22.40

6th Exp. New position of Magnet
7 sec for 2 Rev. = 17.1 Revolutions
Current 2.15 Volts 28
13.6 feet per minute of Roller
Failings 3.18
Dim 60.45 Paling board same

What does 1 Rev of Roller feet weigh per foot of magnet (1 side)?
$\frac{1}{4} \times 6\frac{1}{2} \times 9.6$ = cubic inches 15.6
15.6 × 0.0868 lbs = 1.354
12" magnet interior 8 = 2.03 lbs per turn

#7 Experiment.
~~[illegible]~~ 38 Volts
2.4 Amp.
$5\frac{1}{2}$ sec = 1 turn
11 Revolution
Failings 2.53
Dim 60 45

4·6 | 60·0 | 13·0
62
140
138
·20

17 | 83 | 4·4160
17 | 75
68
70
68
20
15

4·4 | 1·6000
0449
1323
67

8 Exp.

Volts 38
Amp 2·5

10 turns in 46 sec
13 turns per min –
Lading 1.81
Iron 59·36

This is with the bore with brass plate, in which the top edge of floating plate is 4⅞" higher than the other

9 Exp.

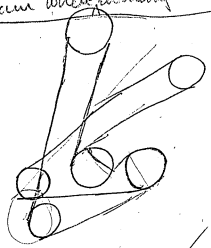
Volts 34
Amp 2·45

~~83 sec 17 Rev 12·2 Rev per minute~~
75 sec 17 Rev 13 Rev per minute
Lading 3·25
Iron – 59·73.

#10 Exp
The tailings of #9 was run through
Volts 32
Amp 2.25

Tailings ⇒ 1.81
Iron

The concentrate was quite considerable in this exp about say 50% ore must try again with stronger magnet + clean to the stream when running tailings



#11 The concentrate of #9 run over again

Amp 2.3
Volts 35

Iron 62.26

#12 The concentrate of #11 was run again

Amp. 2.35
Volts 36

Iron 63.65

Tailings 7.24

Note - the magnet after being on for about 2 hours at above Volt Ampere is about as hot as we dare let it get - Therefore it will not stand more

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#13 The concentrate of #12

Volt 32
Amp 2.3

Iron 65.98

Edison thought here that the Ore has too much coarse in it + he

sieved it & found it at least 20% coarse & he tested this coarse which was the concentrate of #13 it showed

64.36

Jan 10 midnight 1893.

Edison took some of concentrate #13 & blew the dust out of it & it then tested 69.86 – He held it in his hand & blew

Take measurement of magnet etc for Exp 8 & 13 Jan 11 1893

Measurement of magnet etc for exp 6 & the present #13.

1 — 1 $\frac{11}{16}$
2 — 2 $\frac{23}{32}$
3 — 1 $\frac{29}{32}$
4 — 2 3/8
5 —
6 — 9 7/16
7

#14 New Setting of Magnet Jan 11 1893

Amp 2.8

21 Lec 4 Rev. Volts 38.

11.4 Rev per min -

Position of parting board #1

Iron 57.19

Tailings 3.43

#15 Concentrate of #14 run through again

Volts 32

Position of parting board #2 - Amp 2.45

Tailings put into tailings of #14

Iron. 64.43

#16 Concentrates of #15 run through

Position of parting board #3 Volts 32

Amp 2.45

Tailings mixed with tailings of 14 + 15

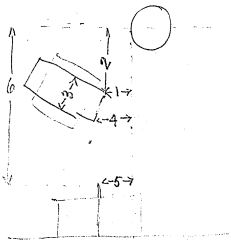
Iron 64.43

#15 non evidently a mistake

#17. Concentrate of #16 run through again —
Volts 32½
Parting board in #4 position Amp. 2.5
Tailings mixed with 14, 15 & 16 —
Iron 65.16

#18 Concent. of #17 run through again
Volts 34
Amp 2.6
Iron 66.97
Tailings mixed with 14 15 16 + 17

Jan 11 1893



1 = $1\frac{15}{16}$
2 = $1\frac{31}{32}$
3 $1\frac{29}{32}$
4 = $2\frac{7}{16}$
5
6 - $9\frac{7}{16}$

#19 Concentrated Sunshine again 1/18

Volts 32
Amps. 2.55

Taking out on the other tailing
Iron 67.33

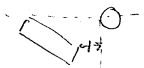
By working dust out (the unkillable) with a magnet we got 70.22, that amount can probably be taken out by the impact machine

20. The accumulations of tailings of 14 to 19 were now run through Parting board #1 position

Volts 37
Amp 2.5

Tailings - 2.71

Position of Magnet for these tailings



#1 $1\frac{7}{16}$

Same every other measure except just made closer.

There were some pieces stuck to the magnet at this setting but this was due to the fact that I broke the magnet at different times when making these tailings + what came off magnet then stuck. It would not occur in practice

1/32

3/16
1 1/32
1 3/64

Tailings of 20 too high so we mix it up again & try 21

#21 Same as #20 but parting board in #½ position —
Volts 36
Amp. 2.5

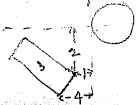
Tailings 1.81

Iron - Jan 11 1893

#22 A new lot run through
= with magnet assembly set + parting board (bore one) in #2 position
Volts 38
Amp. 2.55

Tailings put in pail

Iron. — 57.92
Tailings — 3.62



1 = 1 13/16
2 = 1 3/4
3 =
4 = 2 7/16

23 Current from 22 run through
2nd time
Parking boats #2 position { Volts 30
Amp. 2.3
Iron. 63.16

24 Current from 23 again
3rd time running Volts 32
Amp 2.35
Iron 63.64

$8\frac{5}{8} \times 2\frac{5}{8}$
$7\frac{7}{8} \times 1\frac{7}{8}$

25 Concent run again
4th time { Volts 36
Amp 2.48
board same position

Dem 65.16

26 Accumulation of 4 tailings
22 to 25 Volts 40
Amp 2.55
parting board #1/4

Tailings 2.89
Duplicated " 2.71

By taking these tailings + mixing up again + setting magnet closer + run half speed we got tailings ← 1.44.

✓

27 We now ground enough for the to the through 50 mesh, & tried it—

Volt 38
Amp 2.5
Iron 55.02
Tailings 4.70

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28 Ran em. of 27 a 2nd time
Part. board #1 position
V-38
a-2.5
Iron 57.92

29 Concent of 28 3rd run

Position of board #1 V 38
a - 2·4

Iron - 61·54

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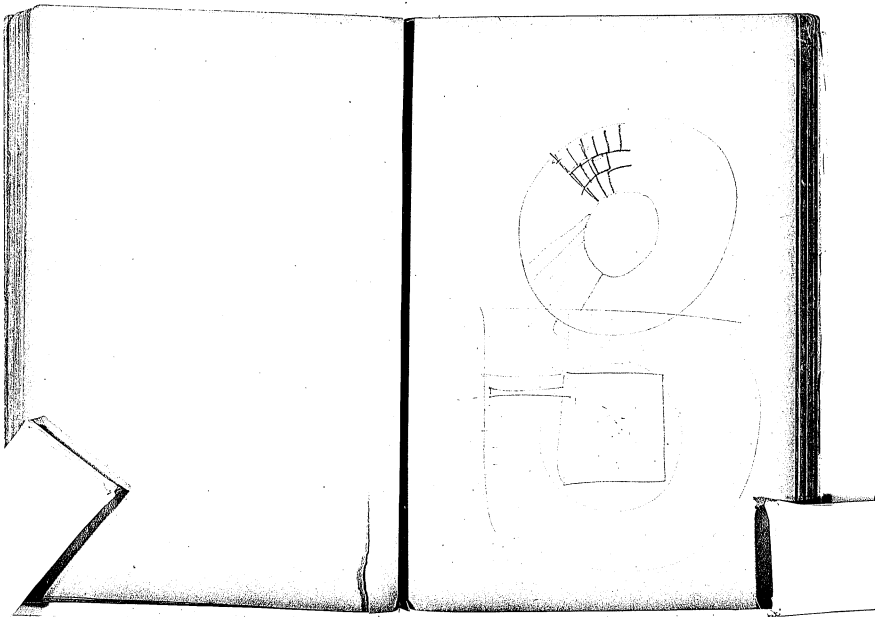
30 Concent of 29 4th Run

Position of board # V 38
a 2·45

Iron 63·17



31 We were lowered the top of
the beating board edge 4"

#3 position for beating board { 40 V. ~~[illegible]~~
2.5 a. ~~[illegible]~~

Gros — 57.92
Tailings — 3.25

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32 Another lot of regular concen

#3 position of board V 30
a 2.20

Gros 60.81
Tailings 4.08

63.36
65.88

33 We kept the magnet up in this manner, the top of the magnet had a plate on so that it could be moved towards the roller stream independent of the magnet. A sheet of thick paper was put in front of the magnet + held in a curve underneath the magnet. The whiskers were allowed to accumulate on the plate at top of magnet + also at the bottom on the paper.

The first run of this with three amps. gave a concentrate of 63.36

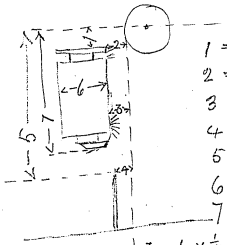
The tailings were not tested

The concentrate was run through again with 3 amp + 22 revolutions and gave a concentrate of 65.88

The tailings of this were added.

to the first & not tested
The second concentrate was run through
again 22 Rev. 3 amp and gave
a 3rd Concentrate of 66.97
The tailings were added to the other 2
The 3rd Concentrate was run through again
at 22 Rev. + 3 amp + gave a 4th
Concentrate of —— 67.05
The tailings were mixed with the other
three + tested before running through
again Iron — 8.32
They were then run through the
machine again with 3½ Amp. + then
they tested 2.17

Dimensions of the magnet & machine as we have it



1 = $1\frac{11}{16}$
2 = $1\frac{1}{16}$
3 = $2\frac{7}{8}$
4 =
5 = $18\frac{5}{16}$
6 = 3"
7 = $10\frac{3}{4}$

Plate on top was $9\frac{7}{8} \times 6 \times \frac{1}{4}$ thick steel & stood over from edge of magnet $2\frac{1}{2}$"
Bottom piece of magnet iron stands flush with side —

Jan 12th 1869
1 a.m.

16 | 75

34 Jan 12 1893

12 Sec 16 turns 75 Res per min

Amp 3

Volts 38

Failing not tested

Current. 61.54

Fail 7.24

35 Current of 34 run again

Amp 3

Volts 42

Failing mixed with the others

Current. 63.71

36. Concert of 35 again through
3rd time V 43
Failing mixed with other Amp. 3.

Concert 64.43

/

~~37~~ Concert ~~of~~ 36 again
4th time V a
Failing mixed
~~Doubtful this through~~

37 Test of tailings of 33.35.
T 36
about 50 Rev per min Volts 39
Amp 2.9
Sum - 2.71

We did not think amperes were quite strong enough as we tried again after removing

38 Test of same tailings is 37
about 50 Rev Volts 52
Amp 3.45

Sum . . 1.44

39. We thought it well to run the tail through a second time & the result was vast { V 53
Q. 3.5
-1 about 50 sec.

tails .88

Jan 12 1893

40 We think we could do better by leaving the sinuosity in the first tailings V 46

Amp 3.0

Iron 62.62

Tails 14.48

---

41 Con. of 40 run 2d time

V 40

a 2.5

Iron. 65.52

Looks much better than tails of 40

42 Cu of 41 a 3rd time
V 40
Cu 2.5
Iron. 66.60

43 The tailings of all were run
V 60
Cu 3.2
Iron: 1.81

V

44 The tailings run 2d time
gave = { V 50
a. 3.2

Drm 1.08

We found a bad place in
our pole pieces so we can
do better than times +
we now fix up with better
pole pieces etc —

✓

80 tons comes over at 4.5%
800 lb. tailings at 20%
How much is that of the total

65.10
10.50

60

70
69.50
68.8

45 We now changed the magnet so that we had same drop and arranged as shown further on

Fourth run — Amp 3.

60 Rev. about Iron 65.10

Tail 10.86

✓

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46 45 Concent run 2nd time

60 Rev. about Amp 3

Iron 68.05

Tail

Tail mixed with the other

✓

50 5,5

21 / 135 / 56 / 210 / 156 / 54 / 1,35 / 63 / 20 / 780

95% goes down

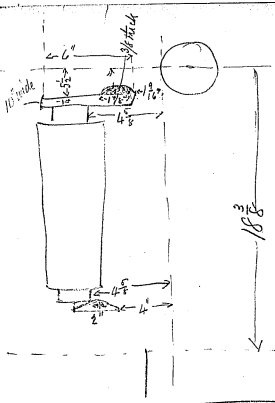
41 Passed 46 Run 3rd time
60 Revolutions V 48
a. 3
Gm 68.78

Tailings ground with the others
this concentrate passed through 100 mesh weighed
Cm. 21 grammes
100 mesh carried 95% of all the dust — What did not go through 135 grams + the

48 Tailings of all now were
Run V 50
Gm 50.00 a 3.5
Lait. 1.44

✓

$$\frac{135\frac{1}{2}}{15\frac{1}{16}}$$

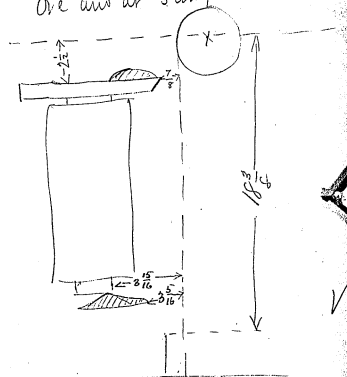


Now for ailings make top of plate $2\frac{1}{2}$" from center of roll and 40 was run with this measurement the magnet being moved towards the drum $\frac{11}{16}$ –

Midnight Jan 12 1893

58.47
1.44

49 With this setting I am. Jan 15th 1893
we now took regular Jan 15th 1893
One and at 3 amp + about 60 revs.



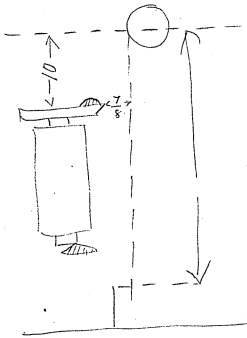
1st run Sm 58.47
Fails 1.44

Fails known away and concent.

Run a 2nd time
60 Rev.
3 amp
Current 59.36
Tails thrown away

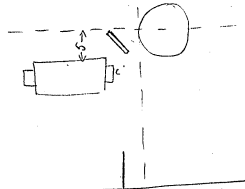
V

50 We now placed it as:-

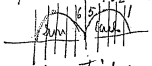


5 was equally taken from the tailing of iron lumps & was the mugwump between

Jan 13 1893



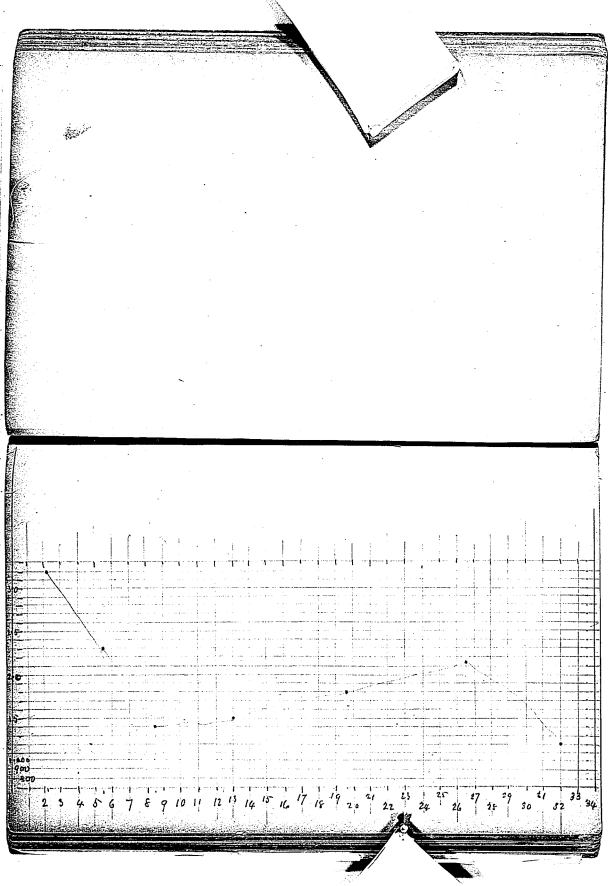
A run was made and the result separated as: #1 beginning at end of tailing pile



A small cartridge shell of each was taken & separated to get the proportion of gold & mugwump in each

	good	mugwump
#1	2.200	3.200
2	5.500	2.300
3	8.500	1.400
4	13.000	1.500
* 5	19.600	1.800
6	26.500	2.150
7	32.000	1.200
8	34.700	0.500
9	35.000	0.800
10	34.700	0.800
	20.800	1.400

A shell full of original showed and weighed 31.150 grams


2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34

52 Same again as 51. Jan 13 1893

%		Gold	Mugwump
1	First Tails	0.150	2.000
2	Second Tails	0.050	2.300
3	Third Tails	0.050	2.200
4	Fourth Tails	0.200	2.300
5	Mugwump Tails	2.300	2.950
6	Bottom dividing line + a little up the hill of Concent	21.200	3.100
7	Concent.	30.700	1.300
8	Concent.	32.800	1.200
9	Concent.	31.450	0.800
10	Last Concent.	34.400	0.900
Original Material		16.800	1.300

Mag 5.00

2.53
1.81
4.34
2.17

5.80
2.900

53 Jan 13 1893

A lot was now run through & the concentrate run again & the concentrate again making 3 times. The tailings were all mixed together

This gave Concent 65.88

Vots 50. Tail. 2.53

Amp 3. Tailings the second time 1.81
average of four "tests" 2.17

The concentrates from remunning the tailings gave for 1 shell load

good	mugwumps
27.600	5.000

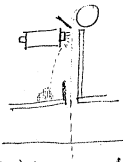
The tailings of this gave

good	mugwumps
0.150	2.900

The above tailing test show that we have got to loose from 2 & 2.5% because it is all mugwumps.

Jan 13 1893

54 We now cut out the table so that the tailings could go through and put a board up at back of the tailing fall, to guard it from wind; the arrangement being intended to get a draft down to carry away dust etc.



Concent 61.54

The ore is fresh and very dusty

55 We now closed in the sides with boards 7½ wide so as to make it a better chamber

62.26

This ore was a little damp — tried again with drier ore

60.63

56

Jan 14 1893

With the machine set as at 55 — we ran through some ore that had been screened by Phelps through a 50 mesh slot screen by gently lifting it up so that it made a screening about 1 lift a second in the direction of the slot

3 amps

Concentrate 63.35 Nickel 38

Tailings 2.29

The mugwump in the Concentrate was very small

The mugwump in the tailings was large ~~The total~~ about 2½ times the good that was in it

This experiment shows that we can use the ~~set~~ machine for this most provided the dust machine works all right

There was a great deal of dust in Concen.

2 a.m. Jan 14 1893

57 With machine set as at 55
we now run through some regular
14 mesh ore

3 Amp
58 Volts

Concent 54.30
Tailings 5.79

The ~~meat~~ material is much too
large as we sieved it through 14
mesh slot screen by moving slowly
in direction of slots and ran
~~it~~ through another lot as shown at
58

58 Regular 14 mesh material screened through 14 mesh slot screen slowly by tipping box on angle & light lowline 3 amp

Concent. 56.11

Tailing 5.25

59 The tailings of this were run through a second time

3 amp

Concent 16.83

Tail 3.98

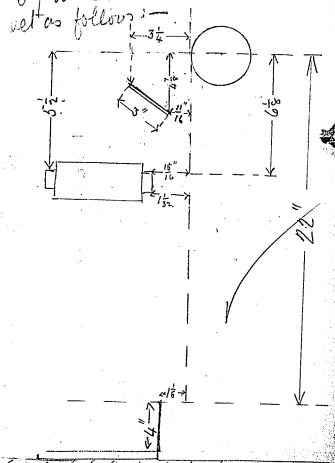
The fall of this is too great from the ~~impact board to the magnet~~ roller feed to the impact board over the magnet & the current should be about 4 amp

16.83

3.4
4

Note 4 a.m. Jan 14 1893

All the experiments from 51 to 59 were tried with the machine set as follows:—



Jan 14 1893

60 We now moved up the magnet antiparallel board 2" otherwise the machine was in the same position - except the brass parting board was used in box

3 amp

Concent 57.19
Tail 3.62.

The tailings were run through a second time & work

3.3 Amp

Concent
Tailings 2.53

The first concentrate of this exp. seemed so low that we thought it looked better than it tested so we tested it again & verify & found

Concent. 56.11

61 Regular 14 mesh stuff passed three times over a 14 mesh sieve 24" long, belts in direction of length)

3 amps.

Concent 57.19
Tails 5.43

The tails were run through again

Am. 3.4

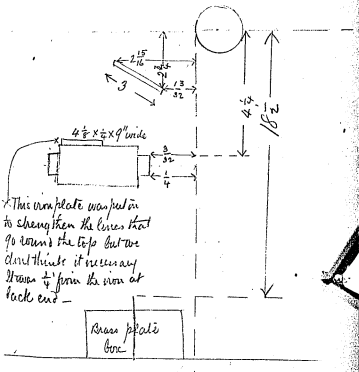
Tails 2.17

A second running of the tails after being mixed up again gave.

1.44

The measurements of the machine for this were as follows: —

over



The two concentrates were mixed together & treated & gave

55.38

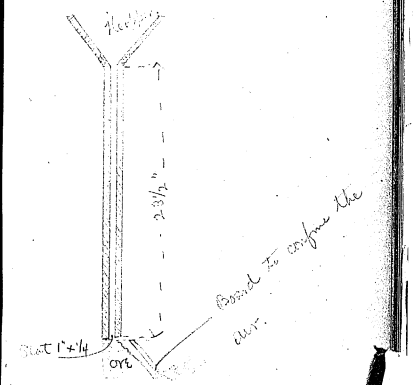
61.54

13. July 2 - 1889 :-

Mr [illegible] Brine -

First [illegible] so much crude from so much [illegible] which averaged 37.35 % we then run through magnet + got 60.5 % + then put it through [illegible] cloth [illegible] page) 15 times and each time ~~[illegible]~~ [illegible] unmagnetic - result after 15 times ~~[illegible]~~ 63.65 % the fines seem to be nearly all gone + only large particles of magnetite left - in this test

We cover out on cover - ~~sizing~~

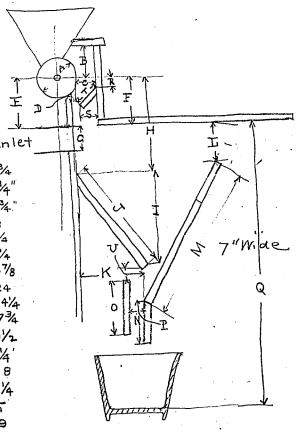


[illegible] same as

[illegible] slot made

square — %

Ducter Experiment Feb. 18. 1893 2. p.m.



A – 5¾
B – 5¾"
C – 2¾"
D – ⅜
E – 9½
F – 9¼
G – 3⅞
H – 24
I – 14¼
J – 17¾
K – 9½
L – 9¼
M – 28
N – 1¼
O – 5
P – 9
Q – 58½
R – 4½
S – 2
T – 3 3/16
U – ⅜

all ⅞ Stuff

$18\frac{1}{2}$
$17\frac{1}{2}$
13

$2\frac{7}{8}$
$3\frac{3}{8}$
$5\frac{1}{8}$

9

Concentrate Seperator Experiment

Feb 16. 1893
12 midnight

2 tons capacity
per foot of Magnet on side out-

18 revs.

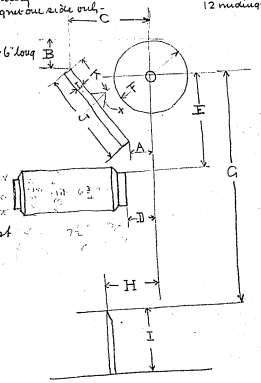
Opening R.F. 1/4" x 6" long

1st 62.08
2nd 63.98

Repeat conc.
Split

Con. 63.53
Tail. 22.08

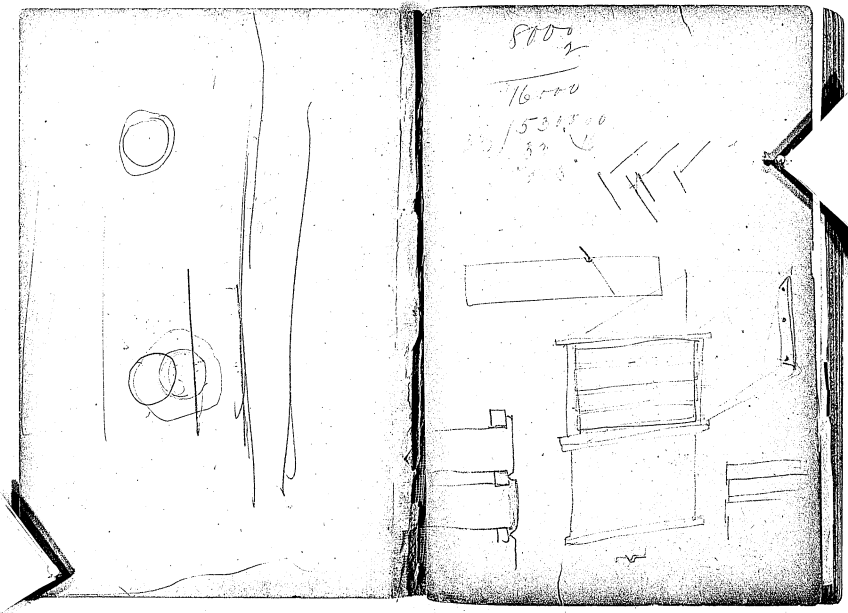
Conc. 62.08.
Wet, dust



A - $2\frac{11}{16}$
B - $2\frac{9}{16}$
C - $4\frac{13}{16}$
D - $2\frac{7}{8}$
E - $2\frac{7}{8}$
F - $5\frac{3}{4}$
G - $18\frac{1}{4}$
H - $2\frac{1}{2}$
I - 7"
J - 3
K - $1\frac{1}{2}$
L - $\frac{3}{8}$

X = is point at which strip from R.F. strucn deflecting board

[THIS BOOK WAS USED IN BOTH DIRECTIONS.
THE FOLLOWING PAGES WERE FILMED FROM
THE BACK END FORWARD.]



126

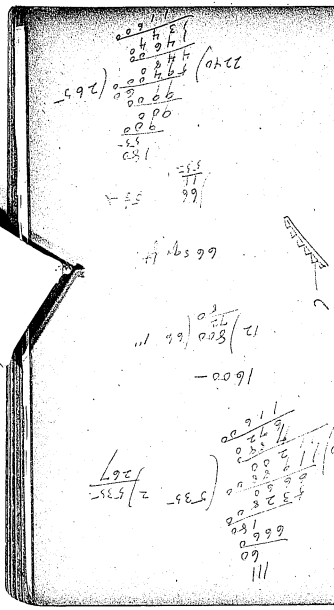
45
31
45
135
395

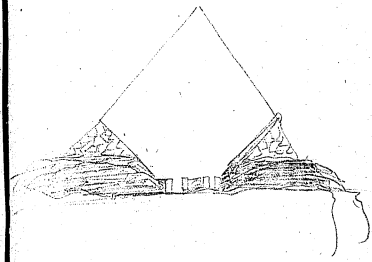
83

2240
1395
8480

2240) 67600 (30 tm
67200
400
20
600

600
3
67) 1800 (26
134
465
402
63





15"
7"
2"
½"
2"

1600 — ½

800 1

66 — 1 ft

$\frac{1}{2}$ $\frac{1}{2}$ —

180

4400

$\frac{1}{2}$ $\frac{1}{2}$

9900

9900

5400

4860

540

1440

1320

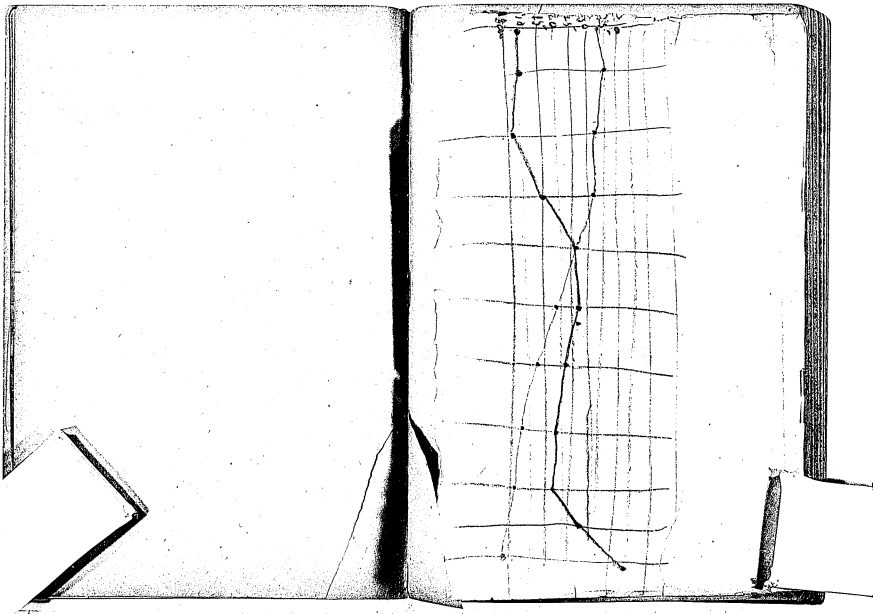
120

2240) 265 —

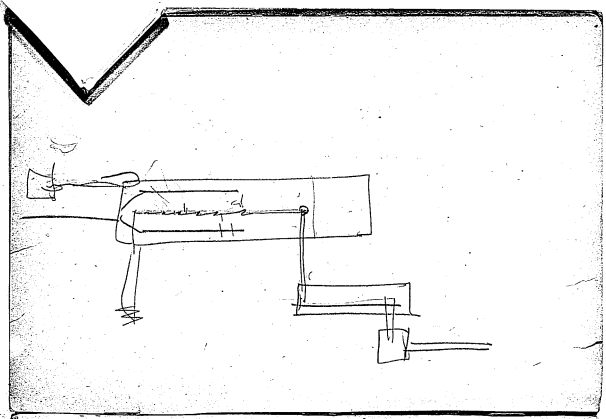
Joe Baggs

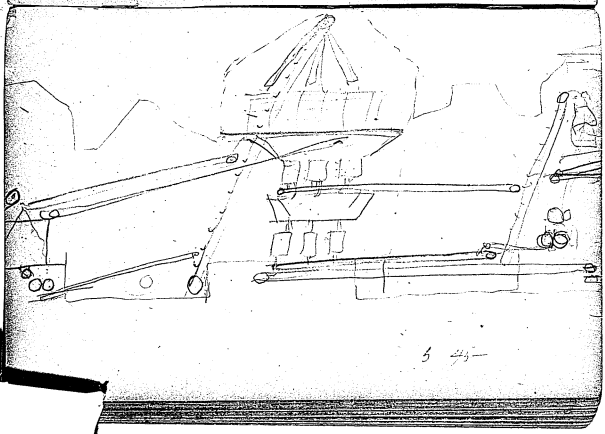
the Butcher

Giant. 6 ft dia 5 ft. face = 1.
Dut. 4 ft " 4 ft " = 1.
Baby. 3 ft. " 3 ft. " = 1.
Microbe 2 ft " 2 ft " = 2.
Fine Babies 3 ft. " 3 ft. " = 4.



Original





5 45

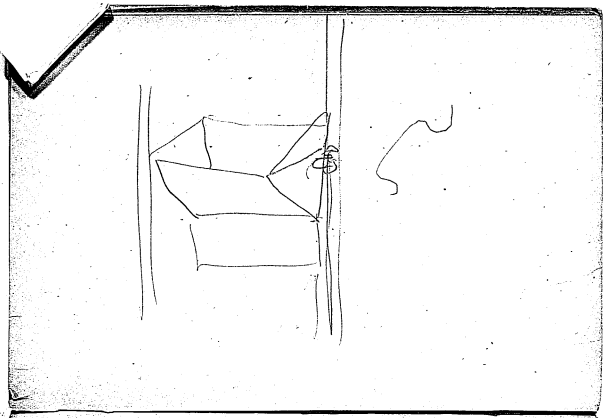
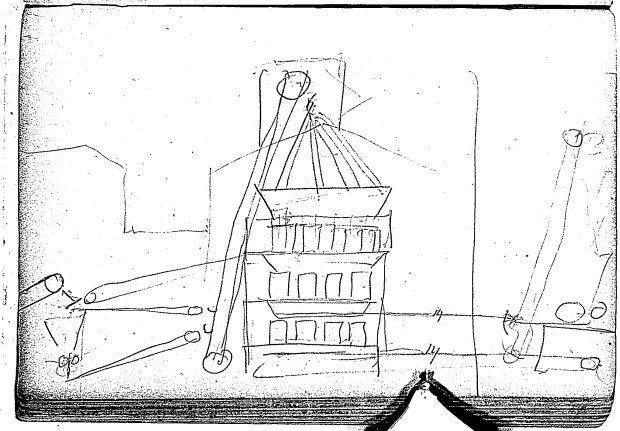
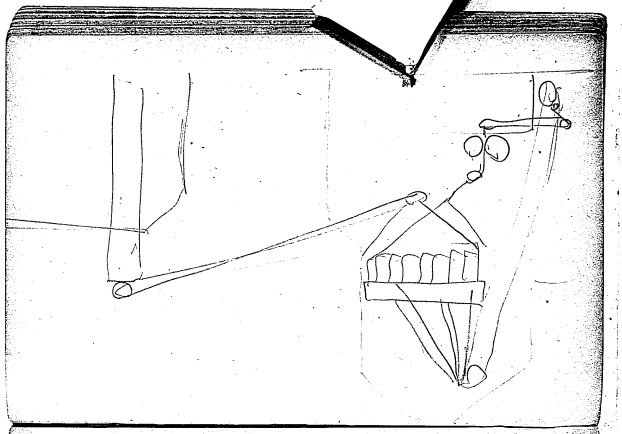
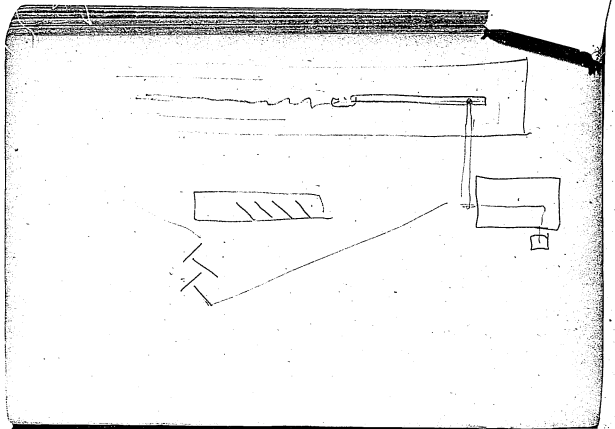
2530
7500 (21.
350) 7500
7000
500

125
18
1000
125
746) 2250
3.

5 145
18
1160
145
1610
2
40.

746) 10000 (130.
746
2540

12. Bar.

125
18
1000
125
1250

12-Bar 125-18 ———— 40.
26 Bells 145-18. ———— 50
50 Arcs - = ———— 50.
100 Duc. = ———— 15.
155